Antimicrobial Stewardship in a Pediatric Hospital Lessons Learned

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Disclaimers

- I have no relevant conflict of interests
- I may discuss off label use of drugs or devices

Learning Objectives

- At the end of the talk attendees should be able to:
  - Recognize the necessity for antimicrobial stewardship programs
  - Describe the essential components of ASP
  - Understand value of ASP for inpatient settings

A story…….

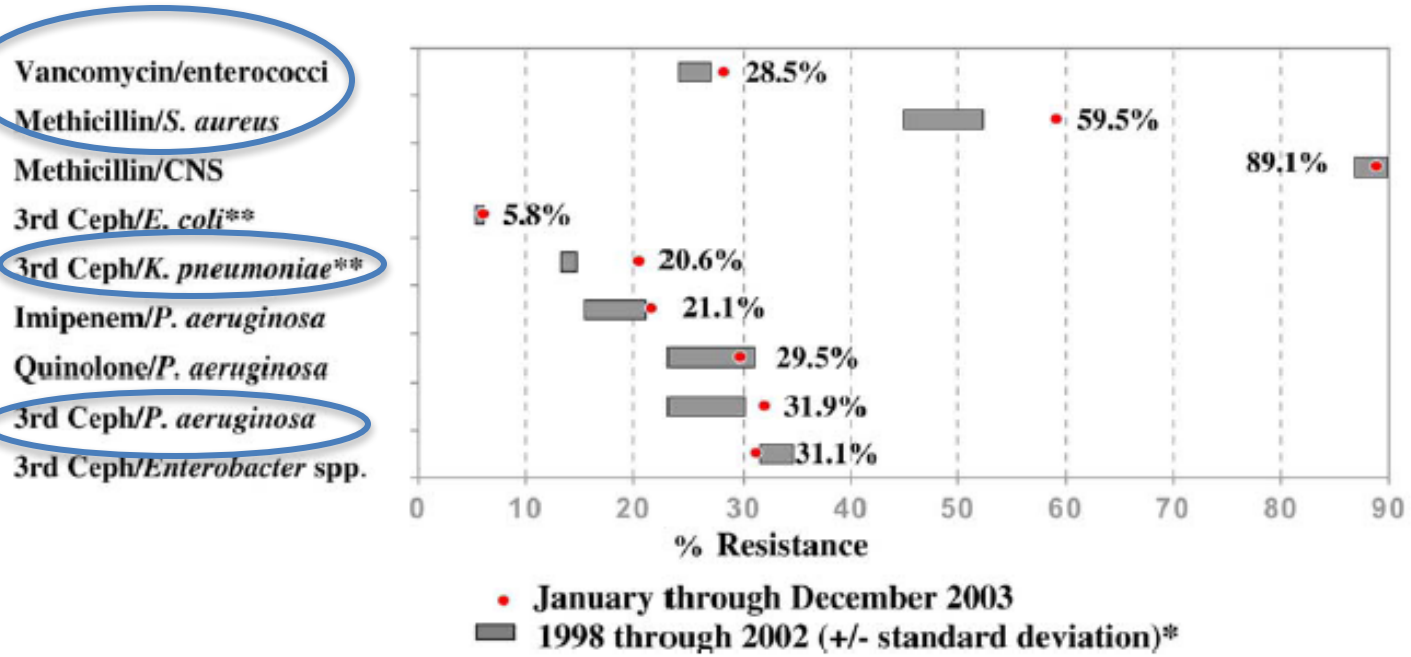
- 2 year old child with leukemia is admitted to PICU with high fever, decreased BP, and respiratory distress requiring resuscitation and ventilatory support
- Vancomycin, meropenem, clindamycin, liposomal amphotericin and high dose acyclovir
- All cultures are negative
- But because "he seems better" they continue antimicrobials
- Kidney dysfunction develops
- Day 10: trach culture has MDR bacteria

What happened?

- This is a sick child
- But doing everything isn't necessarily the right thing ….
- …and can cause harm
- Hopefully an antimicrobial stewardship program (ASP) would help this child avoid untoward side effects…
- ….and help the hospital have less resistant microbes

Origins of Antimicrobial Stewardship: Explosion of Antimicrobial Resistance

Selected antimicrobial-resistant pathogens associated with nosocomial ICU infections: Comparison of resistance rates in 2003 vs. 1998- 2002, NNIS system. Special report NNIS, AJIC 2004



Jan–Dec 2003 No. of Isolates	% increase in resistance (2003 vs 98-02*)
2048	12%
4100	11%
3336	1%
1355	0%
1068	47%
1392	15%
1825	9%
2119	20%
1411	–6%

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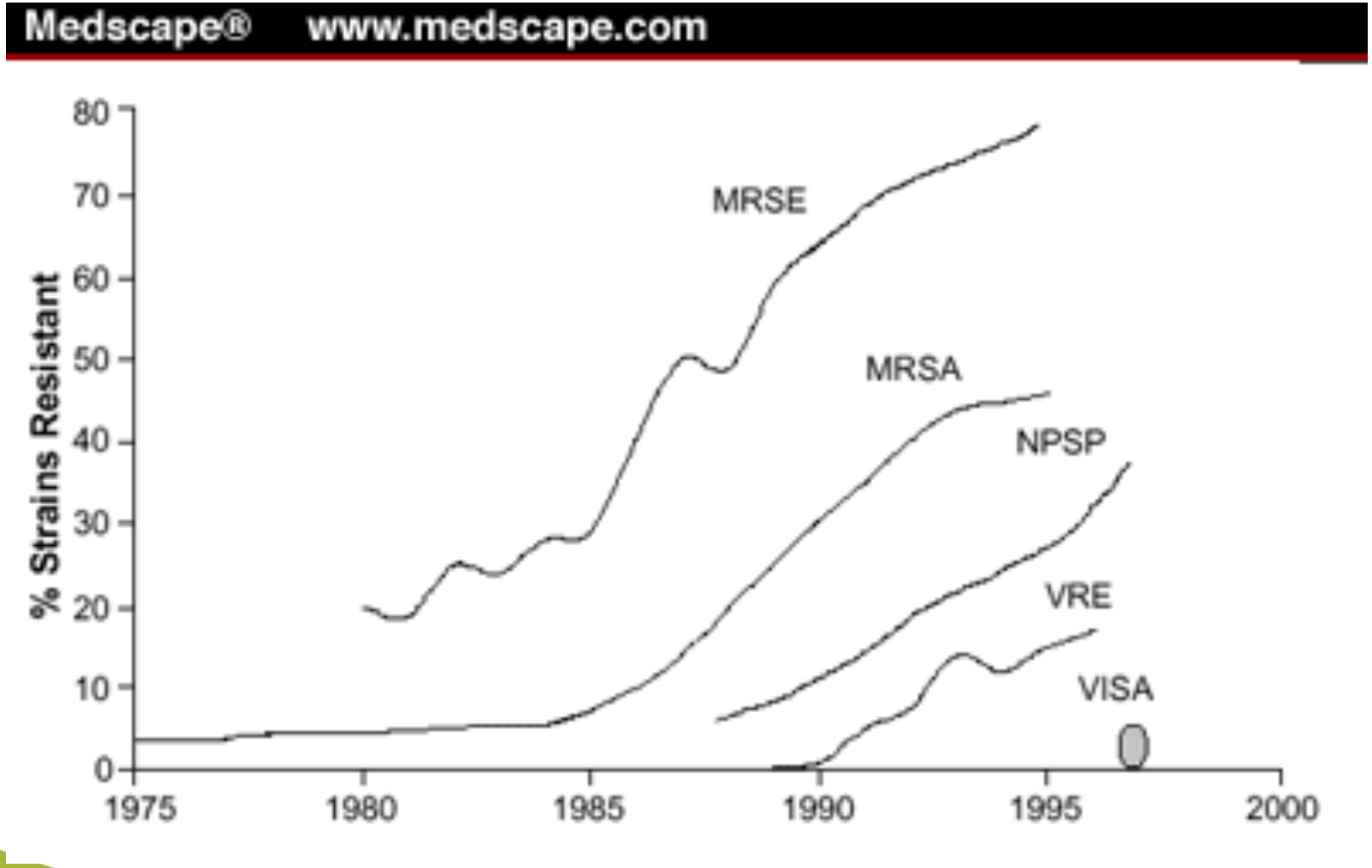
Here Come the Superbugs!



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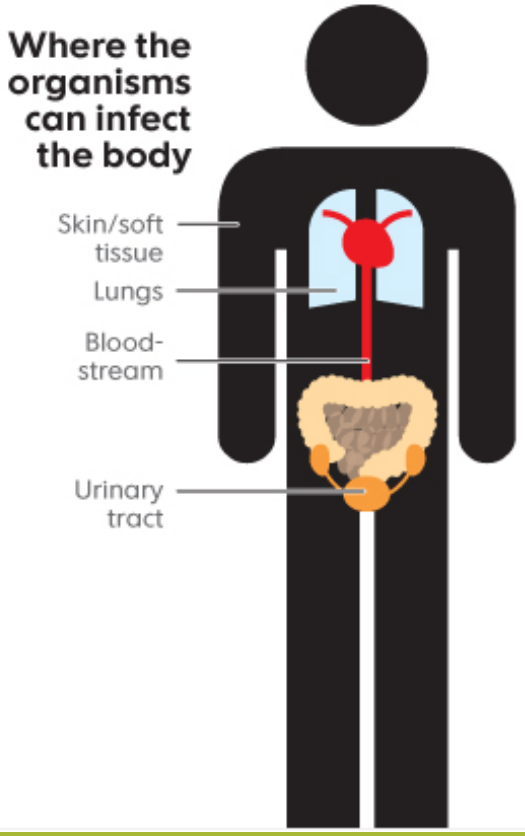
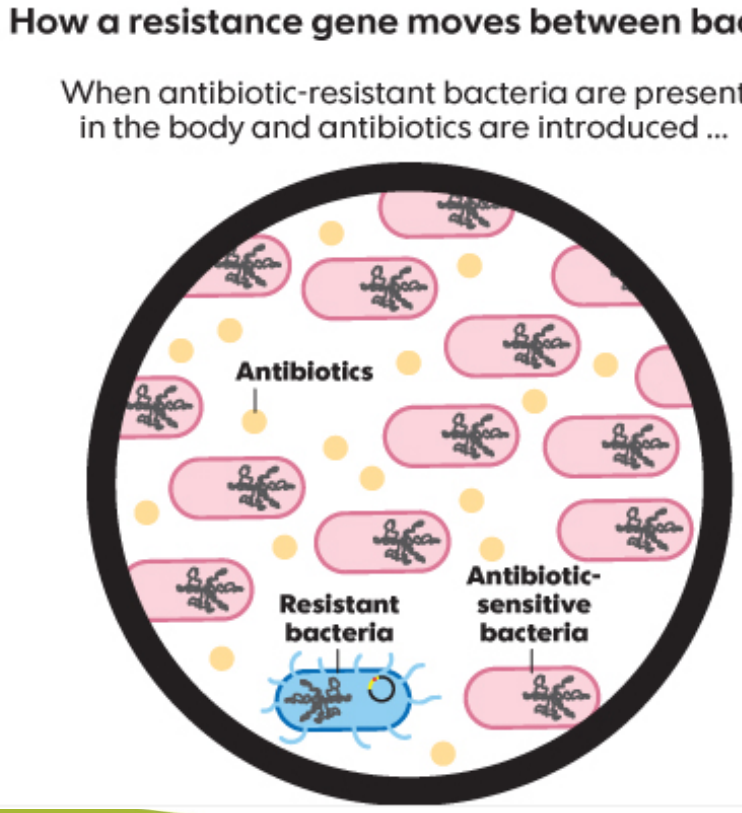
Antimicrobial Resistance hits the News: USA Today (3/6/13)

CDC sounds alarm on deadly, untreatable superbugs

DEADLY BACTERIA THAT DEFY DRUGS OF LAST RESORT

A new family of antibiotic-resistant bacteria, known as CRE, is raising concerns across the medical community because of its ability to cause infections that defy even the strongest antibiotics. The antibiotic resistance is spread by mobile pieces of DNA that can move between different species of bacteria, creating new, drug-defying bugs.





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March 2015

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For Immediate Release

March 27, 2015

FACT SHEET: Obama Administration Releases National Action Plan to Combat Antibiotic-

Slow the Emergence of Resistant Bacteria and Prevent the Spread of Resistant Infections

Judicious use of antibiotics in healthcare and agricultural settings is essential to slow the emergence of resistance and extend the useful lifetime of effective antibiotics. The CDC estimates that up to half of all human antibiotic use is unnecessary or inappropriate. The Action Plan includes activities to foster improvements in the appropriate use of antibiotics (i.e., antibiotic stewardship) by improving prescribing practices across all healthcare settings. , preventing the spread of drug-resistant threats in healthcare facilities and communities, and continuing to eliminate the use of medically-important antibiotics for growth promotion in animals.

By 2020, significant outcomes in this area will include:

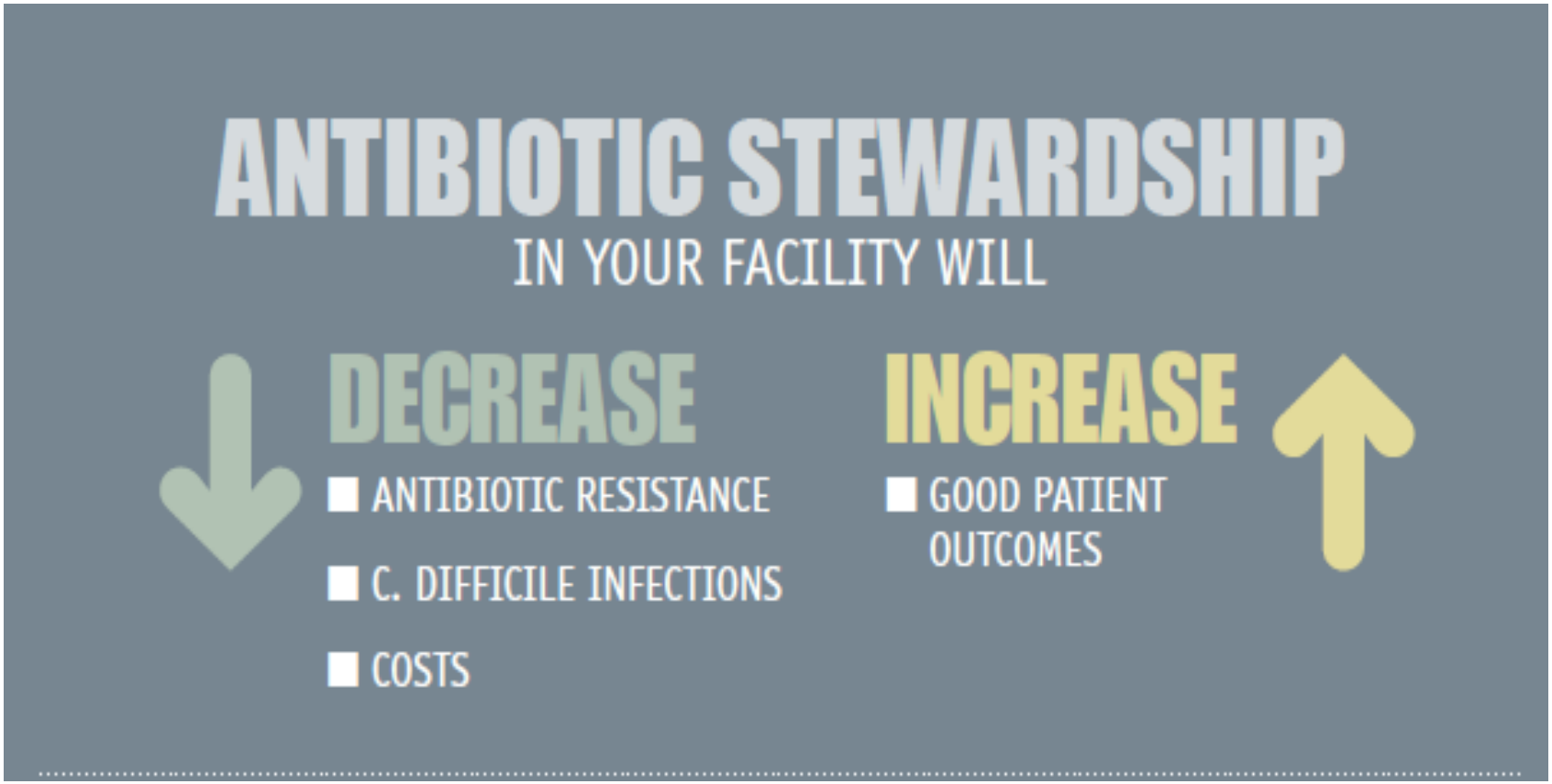
- Establishment of antimicrobial stewardship programs in all acute care hospitals and improved antimicrobial stewardship across all healthcare settings.
- Reduction of inappropriate antibiotic use by 50% in outpatient settings and by 20% in inpatient settings.
- Establishment of State Antibiotic Resistance (AR) Prevention (Protect) Programs in all 50 states to monitor regionally important multi-drug resistant organisms and provide feedback and technical assistance to health care facilities.
- Elimination of the use of medically-important antibiotics for growth promotion in food-producing animals.

Four Core Actions to Fight Resistance

(http://www.cdc.gov/drugresistance/pdf/4-2013-508.pd

1. Prevent infections & spread of resistance
2. Track rates of resistance over time
3. Improve Antibiotic Prescribing / Antimicrobial Stewardship
4. Develop New Drugs & Diagnostic Tests

What Can ASP DO?



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ASP Strategies: Inpatient Focus

- Core strategies
  - Formulary restriction and preauthorization
  - Prospective audit with intervention and feedback
- Supplemental Strategies
  - Education
  - Clinical Guidelines
  - IV to PO conversion
  - Dose optimization
  - Antimicrobial Order Forms

Newland & Hersh/PIDJ/2010

ASP Core Strategies: PROS

- Preauthorization:
  - ↓starting unnecessary/inappropriate Abx
  - Direct control of chosen Abx use/ cost
  - Prompts review of available data at time of initiation of Abx

- Prospective audit and feedback:
  - Review when more clinical data available
  - Greater flexibility in timing of recommendation
  - Prescriber autonomy maintained
  - Can address de-escalation, duration & switch to oral Abx

Barlam et al CID 2016 IDSA Guidelines

ASP Core strategies: Cons

- Preauthorization:
  - Only impacts "chosen Abx"
  - Real-time resource intensive
  - May delay therapy
  - Loss of prescriber autonomy

- Prospective audit and feedback:
  - Compliance voluntary
  - Typically labor –intensive
  - Requires technology support

Barlam et al CID 2016 IDSA Guidelines

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Antimicrobial Stewardship Program: CHP

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CHP: Then

- > 30 yrs preauthorization approval for "restricted antibiotics" by ID group
  - Not approved for children – Ex: quinolones
  - Very broad spectrum drugs – Ex: carbapenems
  - Expensive new drugs- Ex: linezolid
  - Direct towards "drugs of choice"
- Downside:
  - No tracking of antibiotic use once approved
  - Development of antimicrobial resistance
  - No formal antimicrobial stewardship program

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Antimicrobial Susceptibility Tracking

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Models of ASP:

"Traditional Model" Includes Involvement of:	CHP Model Includes Involvement of:
• ID Physician Leader	• ID Physician Leader & Full ID Division
• Dedicated ASP Pharmacist with ID Training	• Team of 7 Service-based Pharmacists
• Pharmacy Director	• Pharmacy Director
• P&T Committee	• P&T Committee
• Infection Prevention	• Infection Prevention
• Informatics	• Informatics
• Hospital Administration	• Hospital Administration

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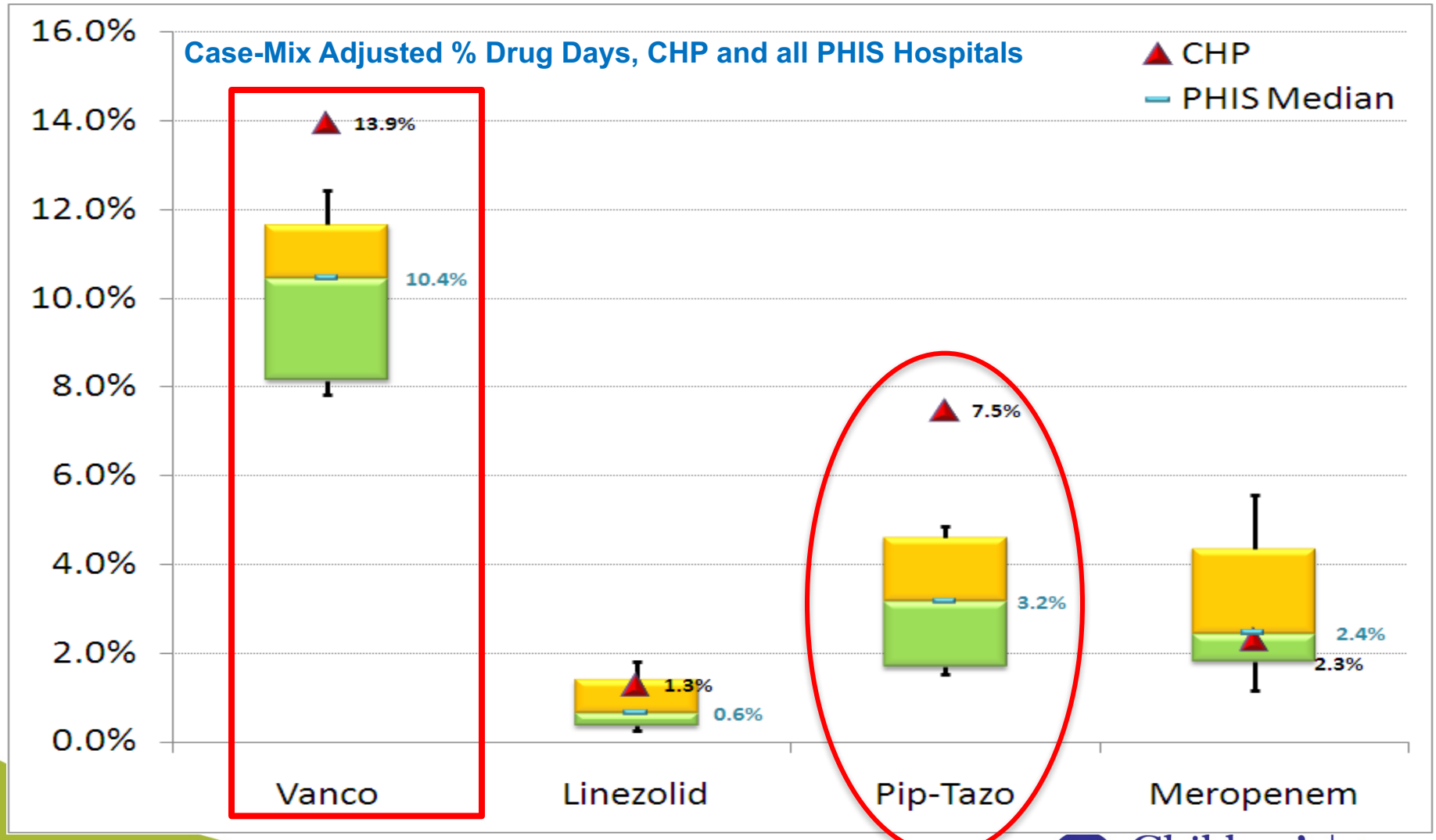
PHIS Antimicrobial Analysis: 2007



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Levin J, 2007, Unpublished Data

ASP AT CHP: 2008

A Quality Assessment of a Collaborative Model of a Pediatric Antimicrobial Stewardship Program

Phuong-Tan Nguyen-Ha, PharmD,[a] Denise Howrie, PharmD,[a] Kelli Crowley, PharmD,[a] Carol G. Vetterly, PharmD,[a] William McGhee, PharmD,[a] Donald Berry, RPh,[a] Elizabeth Ferguson, PharmD,[a] Emily Polischuk, Pharm D,[a] Maria Mori Brooks, PhD,[b] Jeffrey Goff, RPh, MS,[a] Terri Stillwell, MD, MPH,[c] Toni Darville, MD,[d] Ann E. Thompson, MD,[e] James E. Levin, MD, PhD,[f,†] Marian G. Michaels, MD, MPH,[f,g] Michael Green, MD, MPH[f,g]

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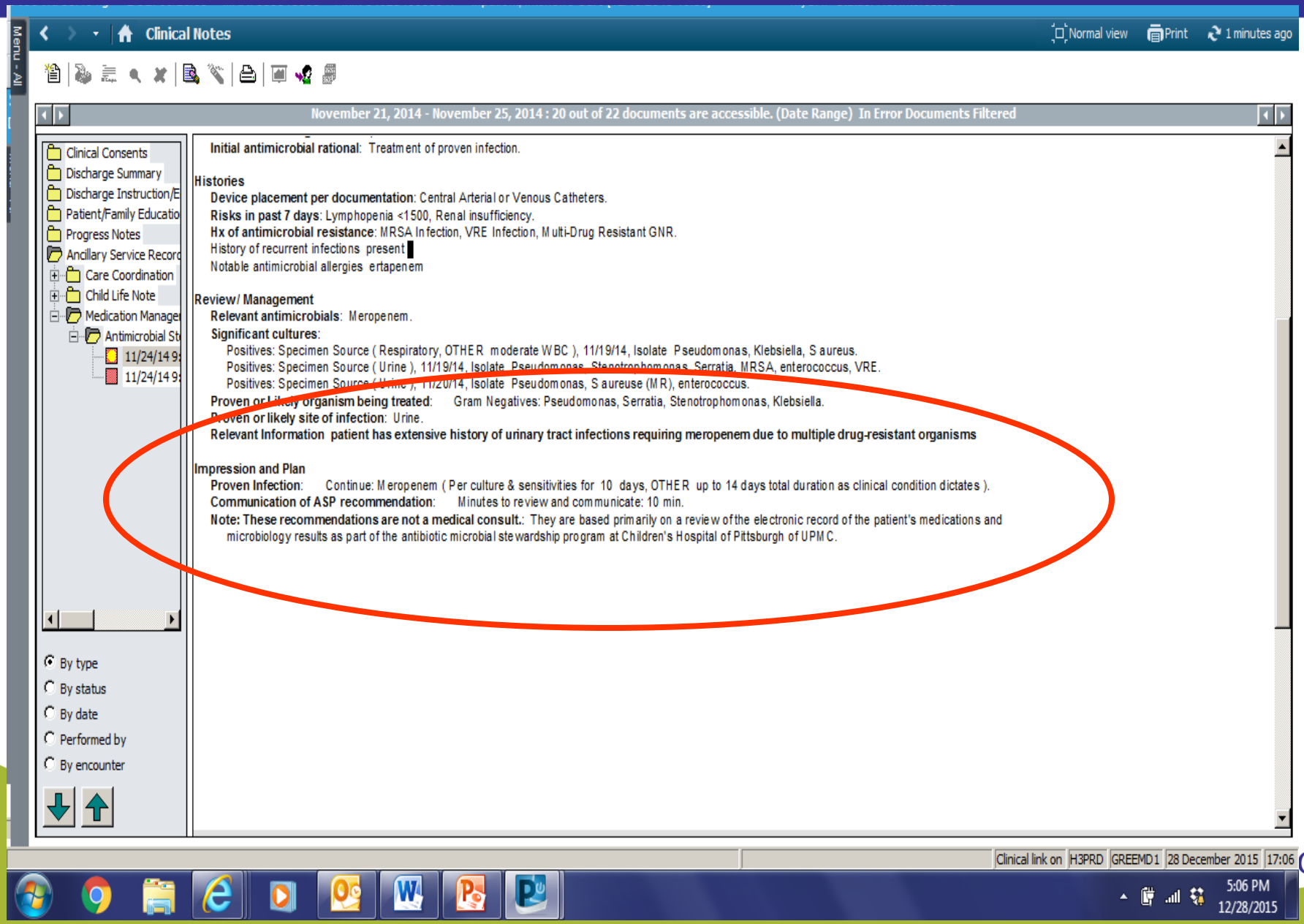
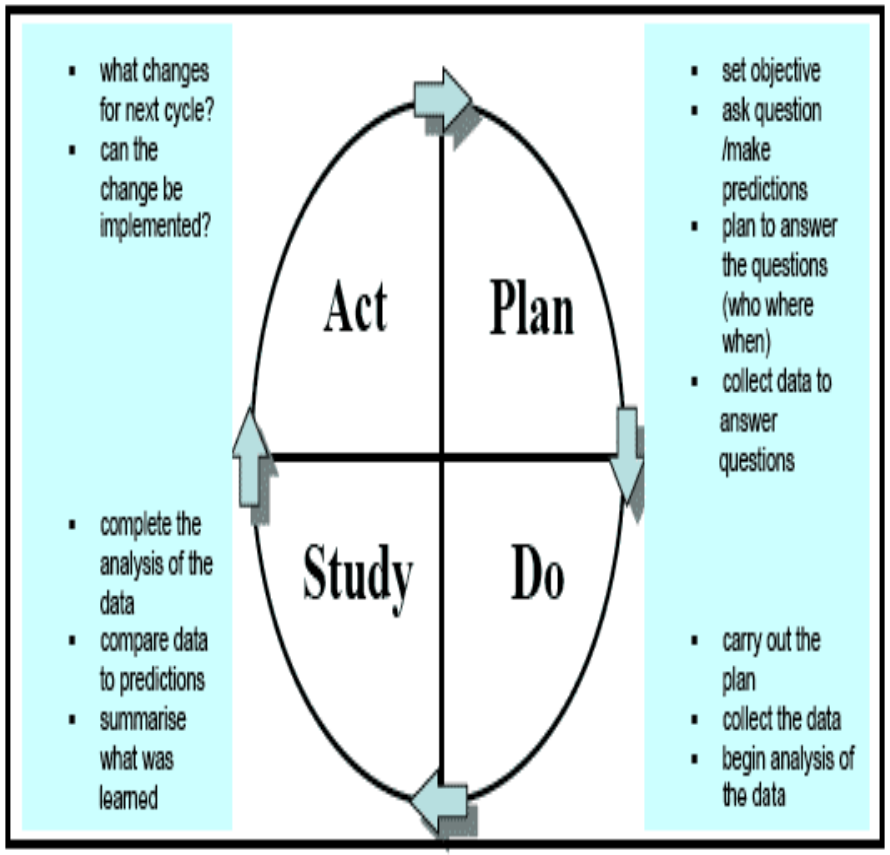
CHP ASP: Development of Guidelines

- Multistep process: targeted antimicrobials
  - Review of literature
  - Small group meeting with representatives from key stakeholder groups
  - Development of "draft" guideline followed by review by full stakeholder groups, P & T Committee and Clinical Resource Management Committee
- Approved guidelines = basis for Day 3 Audits
- Guidelines include:
  - Post-op prophylaxis & antifungal use for Liver & Intestinal Tx
  - Use of ciprofloxacin & vancomycin for IBD patients
  - Use of meropenem (all CHP patient populations)
  - Empiric antimicrobial regimens for surgical infants in NICU
  - Empiric antimicrobial regimens in the CICU

Communicating Recommendations



Tracking Results to Enhance Quality



- The **PDSA cycle** is shorthand for testing a change by developing a plan to test the change **(Plan),** carrying out the test **(Do),** observing and learning from the consequences **(Study),** and determining what modifications should be made to the test **(Act)**

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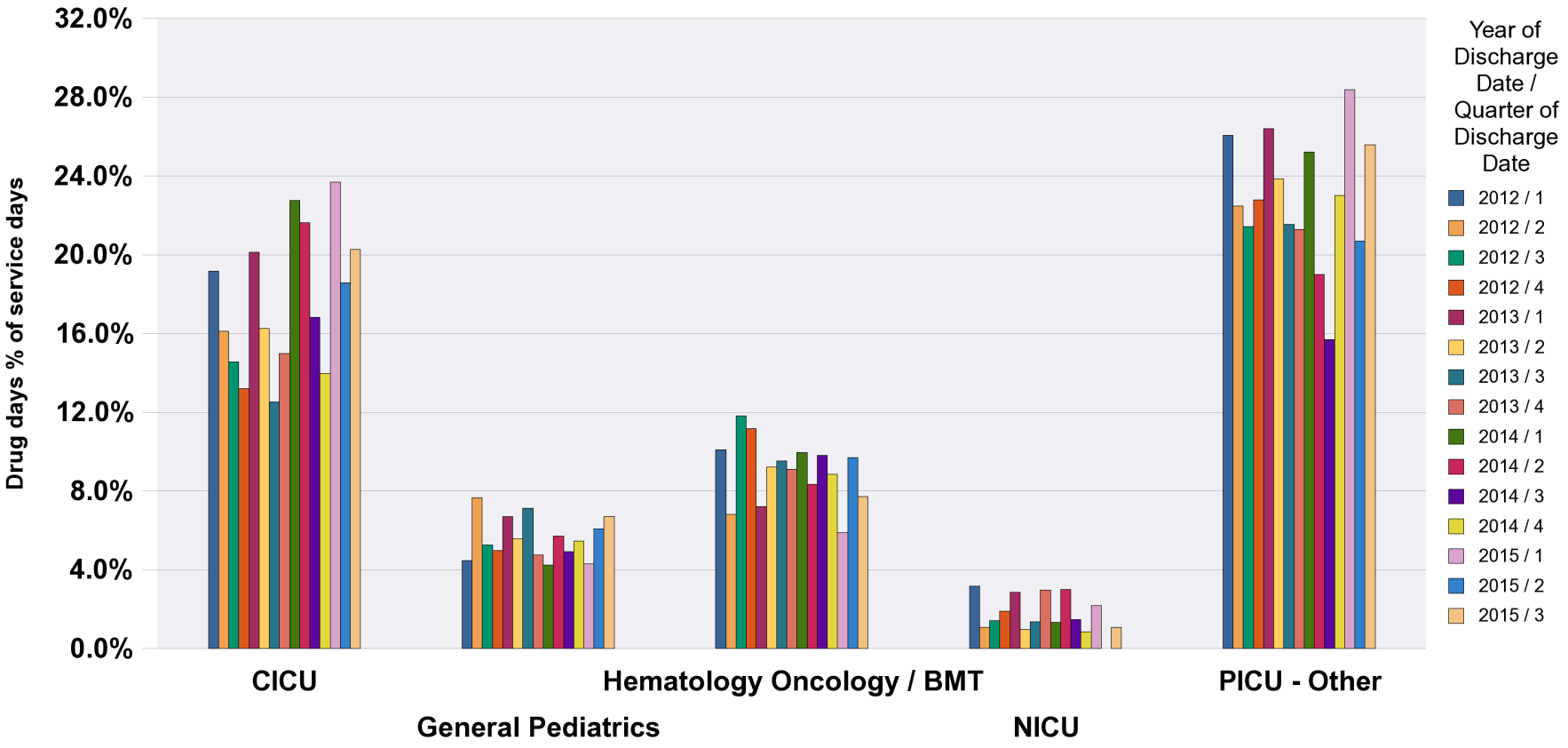
Data Warehouse Track Results over Time



Quarterly reports generated automatically from Data warehouse

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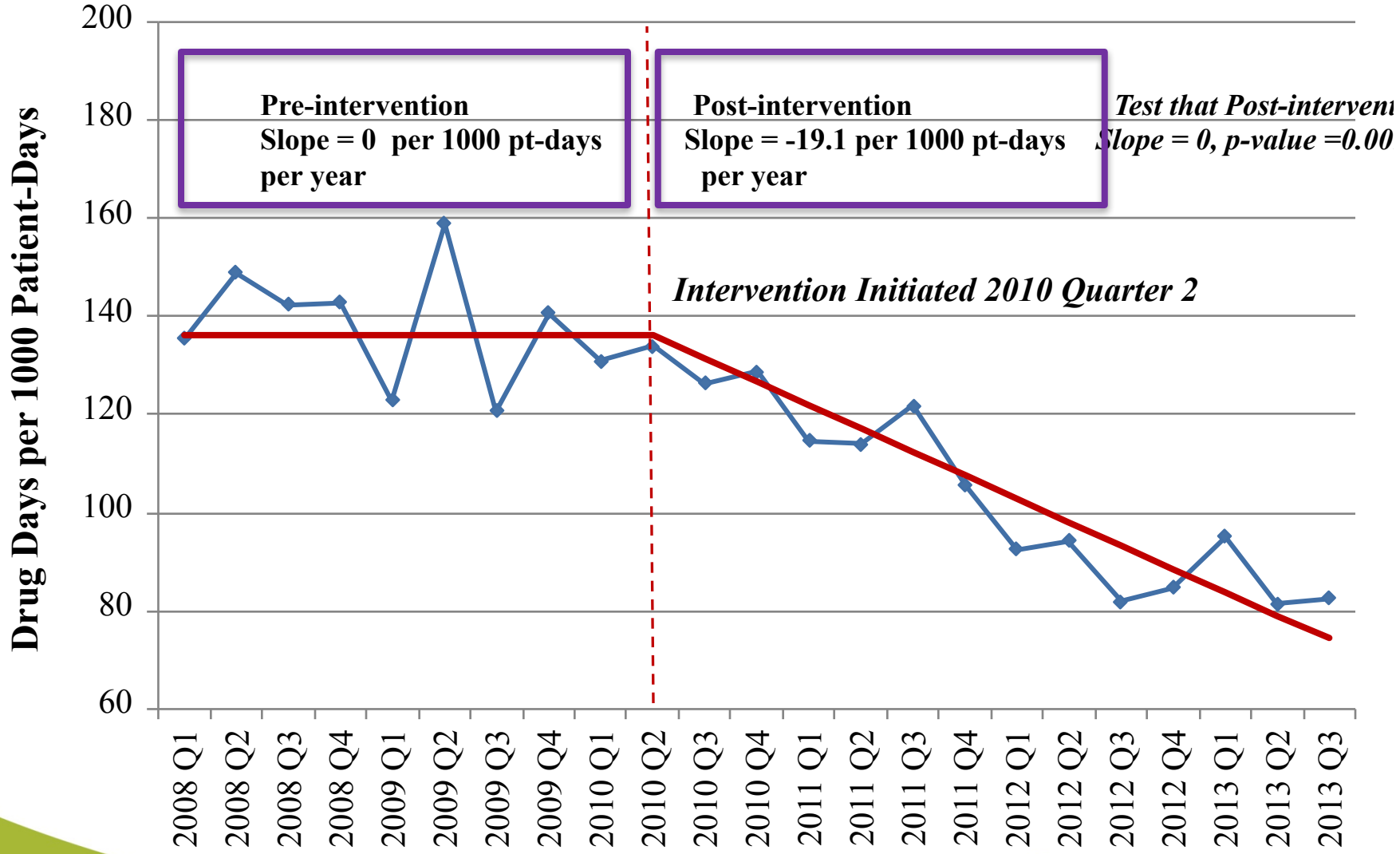
Antimicrobial Stewardship At CHP: Where are we now?

- ASP officially in use since January 2009
- Still require ID Pre-approval for selected Abx
- Guidelines for use of "targeted" antimicrobials developed with stakeholders
- Day 3 Auditing for caspofungin, meropenem & vancomycin
- Results reviewed as part of PDSA process on quarterly basis
- The role of ASP established in culture of CHP

Vancomycin Drug Use



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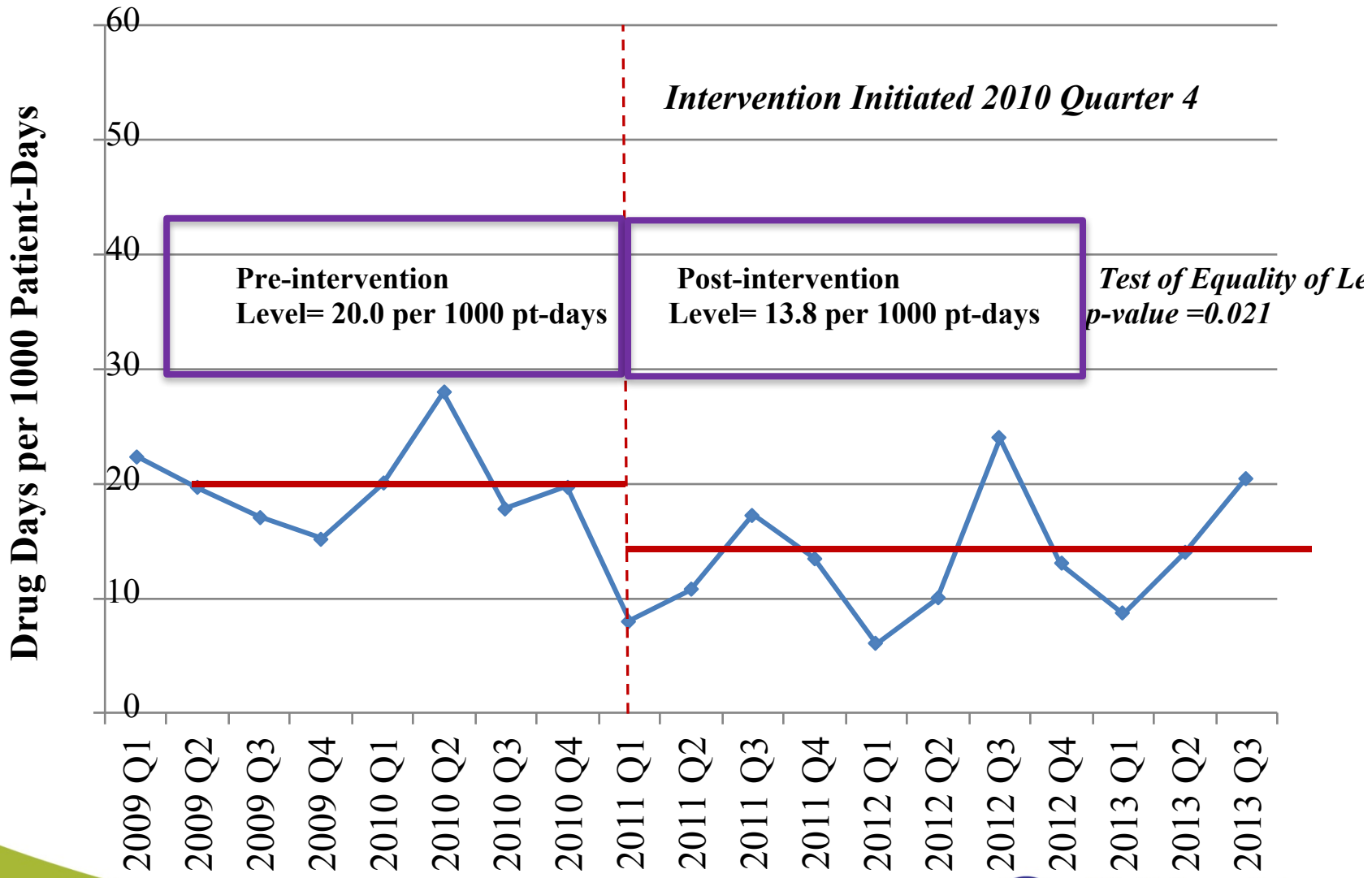
Meropenem Drug Use



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Guidelines: Another story:

- 5 year old girl worsening abdominal pain, fever and vomiting x 3 days
- Comes to Emergency Department
  - Paucity of bowel sounds
  - Rebound tenderness
  - Diagnosed with ruptured appendicitis
- Laparascopic surgery performed
- Ertapenem given
- PIC line placed, home on IV abtiotics for two or more weeks

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Appendicitis Guidelines CHP

- Surgical NPs and MDs noted problem with prolonged antibiotic use
- Prolonged use of PIC lines
  - Complications:
  - thrombus, line infection, *C diff*
- Could we do better?
- Met with ID and PharmD
  - Literature review
  - Development of guidelines
  - Buy in from all surgeons

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Appendicitis

Surgeon consulted in ED or direct admission

Diagnosis: Appendicitis

Admit

Initiate Pre-op Power Plan

Pre-op Power Plan
- Admit to
- Up ad lib
- NPO
- VS q 4 hr
- Strict I & O
- CBC diff and platelets
- Electrolytes, BUN, creat (consider BMP)
- UA
- HCG, Qual urine (female >/= 12 years old
- Abdominal Ultrasound Limited (RLQ) OR consider Pelvic Ultrasound for female OR consider CT abdomen and pelvis with contrast if diagnosis is unclear versus 24 hr obs
- Cefoxitin – IV q 6 hr STAT and on-call OR PCN allergy then:
  - Flagyl IV q 8 STAT and on-call
  - Cipro IV q 12 ISTAT and on-call
- Morphine IV PRN
- Consider Consult pain service
- Dex 5% with 0.45% NaCl + 20 mEq/L KCL
- Education pre op
- Education post op

Timeframe: *Inpatient or Observation up to 24 hours prior to surgery*

Pathology ← **Operate**

Non-operative Appendicitis: (Defined as patients with CT findings of perforated appendicitis with discrete abscess)
- Admit to
- OOB TID
- NPO
- VS q 4 hr
- Strict I & O
- Notify MD Temp >/= 38.5
- Dex 5% with 0.45% NaCl + 20 mEq/L KCL
- Ertapenem IV q 12 hr OR every day (Will transition to PO antibiotics to complete 7 day course of antibiotics when pt. meets discharge criteria.)
- Morphine IV PRN pain
- Consult Interventional Radiology for drainage of intraabdominal abscess

Diagnosis: Uncomplicated Appendicitis

Diagnosis: Complicated Appendicitis

Discontinue Pre-op Power Plan

Discontinue Pre-op Power Plan

Post-op Appendectomy Power Plan Uncomplicated sub-phase

- **Admit to –**
  - Acute appendicitis
  - Gangrenous appendicitis
- OOB TID
- Regular diet
- VS q 4 hr
- Strict I & O
- Notify MD Temp >/= 38.5
- Dex 5% with 0.45% NaCl + 20 mEq/L KCL
- Saline lock when tolerating clears
- Oxycodone PRN pain
- Tylenol PRN pain
- Discharge Alive - conditional upon tolerating regular diet, adequate pain control with PO medications and ambulating without difficulty
- Education post op

Timeframe: *6 to 24 hours post op*

Discharge

Timeframe: *Variable Min 24 hour stay, IV antibiotics*

Post-op Appendectomy Power Plan Complicated sub-phase

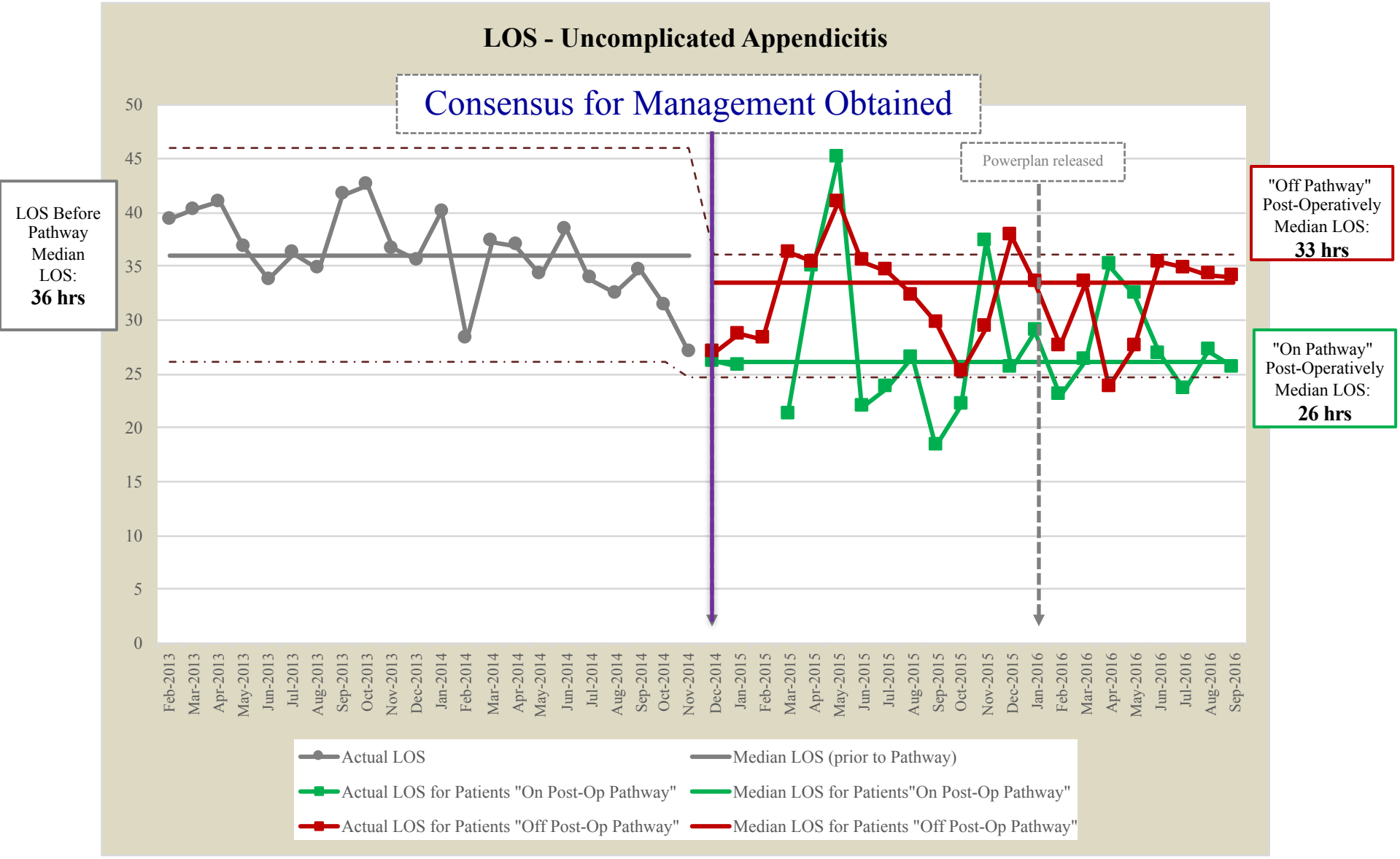
- Admit to:
  - Perforated appendicitis
  - Perforated appendicitis with abscess
- OOB TID
- NPO, Clear liquids, regular diet
- VS q 4 hr
- Strict I & O
- Notify MD Temp >/= 38.5
- NG tube to suction (low continuous) if present
- Ng tube output replacement (1mlLper mL loss, q 4 hr)
- Notify MD urine output < 1 ml/kg/hr x 2 hr
- Foley cath to gravity if present
- Dex 5% with 0.45% NaCl + 20 mEq/L KCL
- Saline lock when tolerating clears
- Ertapenem IV q 12 hr OR every day, will transition to PO antibiotics to complete 5 day course of antibiotics when patient meets discharge criteria
- Morphine IV PRN pain
- Oxycodone PO PRN Pain
- Tylenol PRN pain
- Education post op

•CE #: 302.00 Origination: 12/2015 Revised Dates:

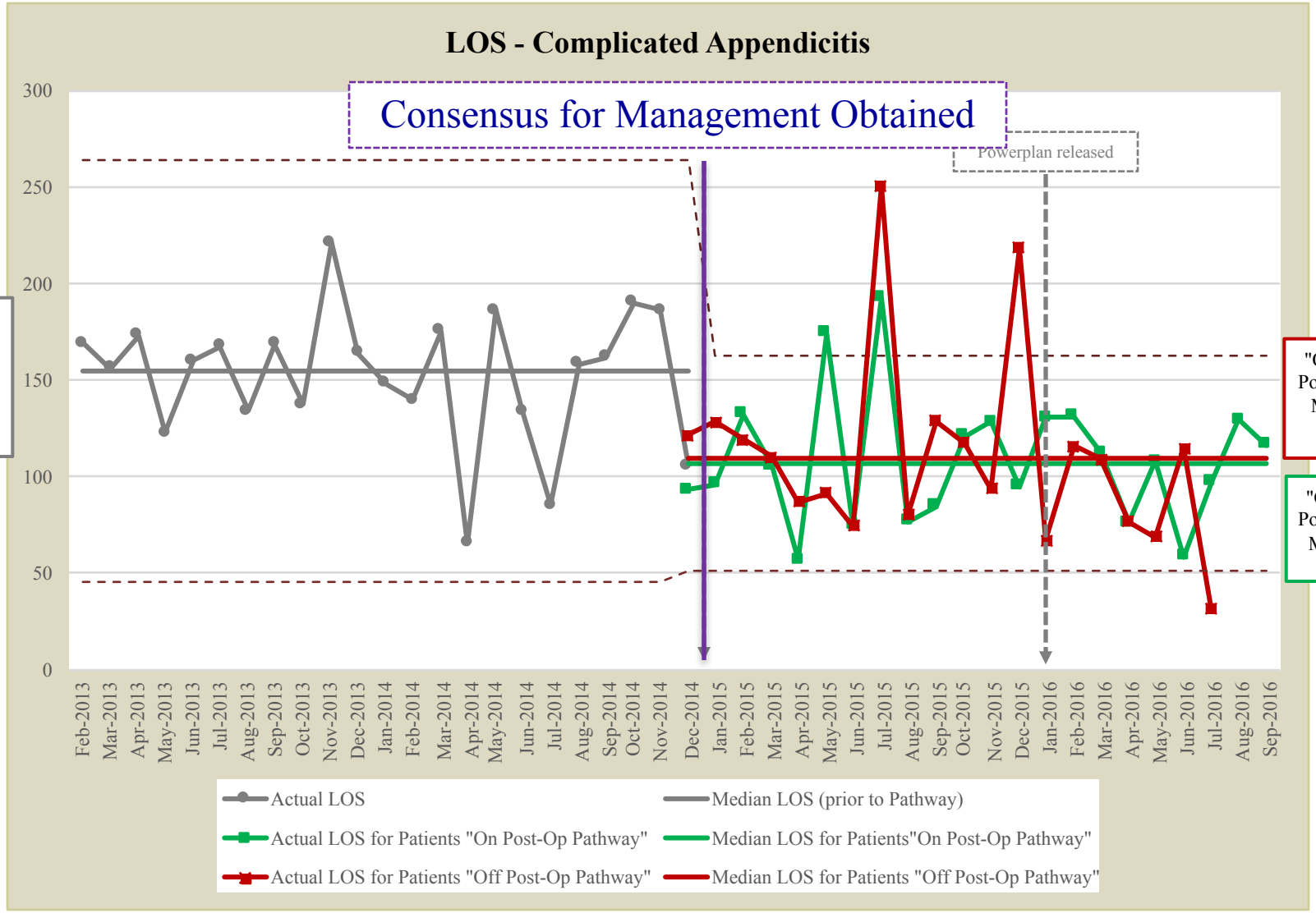
Summary of Guidelines

- Perforated appendicitis
  - At 24 hours: stable and meet d/c criteria
    - Change to oral antibiotics (5 days total Abx)
- Complicated appendicitis
  - When afebrile can be switched to oral Abx for total of 7 days
- Follow up phone call: set questionnaire by pediatric surgical RN
    - Screen positive come back to clinic

Difference in Length of Stay (LOS) "On" vs "Off" Pathway Post-Operatively



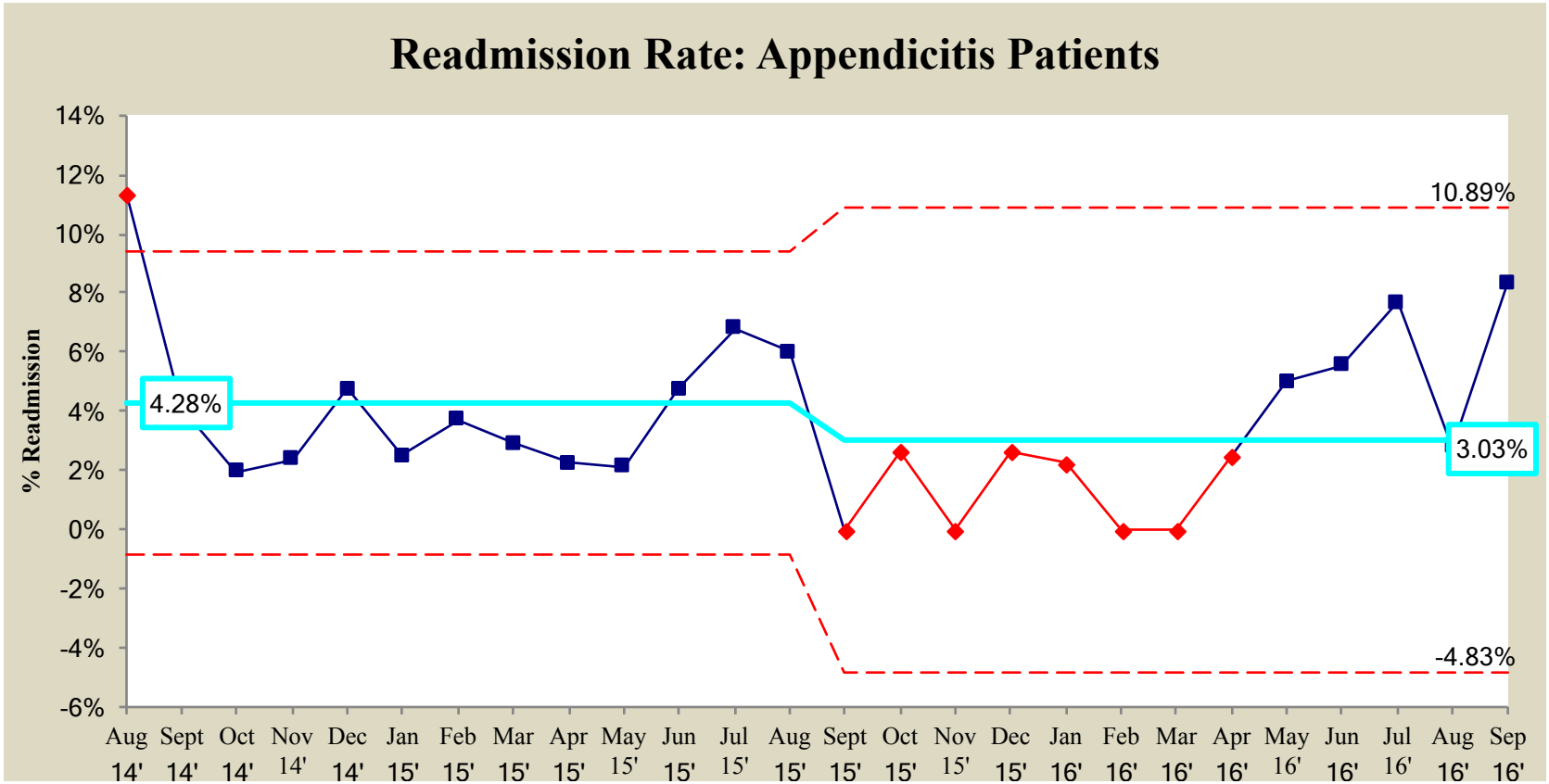
Difference in LOS
"On" vs "Off" Pathway Post-Operatively



LOS Before Pathway Median LOS: **155 hrs**

"Off Pathway" Post-Operatively Median LOS: **110hrs**

"On Pathway" Post-Operatively Median LOS: **107 hrs**


Readmission Rate: Appendicitis Patients
% Readmission
14%
12%
10%
8%
6%
4%
2%
0%
-2%
-4%
-6%
10.89%
4.28%
3.03%
-4.83%
Aug 14'
Sept 14'
Oct 14'
Nov 14'
Dec 14'
Jan 15'
Feb 15'
Mar 15'
Apr 15'
May 15'
Jun 15'
Jul 15'
Aug 15'
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Jun 16'
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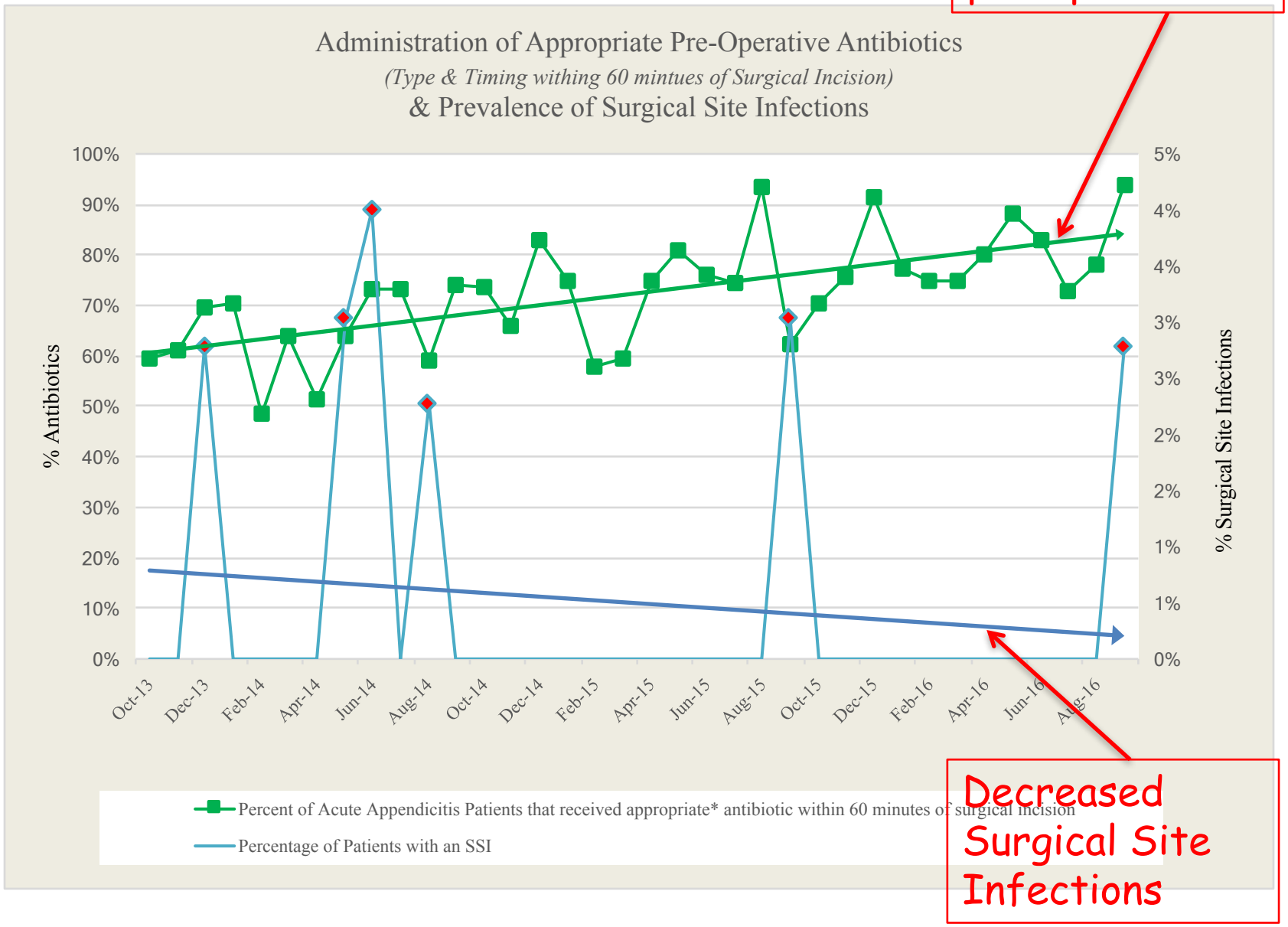
Aug 16'
Sep 16'


Appropriate pre-op Abx
Administration of Appropriate Pre-Operative Antibiotics
(Type & Timing withing 60 mintues of Surgical Incision)
& Prevalence of Surgical Site Infections
% Antibiotics
% Surgical Site Infections
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
5%
4%
4%
3%
3%
2%
2%
1%
1%
0%
Oct-13
Dec-13
Feb-14
Apr-14
Jun-14
Aug-14
Oct-14
Dec-14
Feb-15
Apr-15
Jun-15
Aug-15
Oct-15
Dec-15
Feb-16
Apr-16
Jun-16
Aug-16
Percent of Acute Appendicitis Patients that received appropriate* antibiotic within 60 minutes of surgical incision
Percentage of Patients with an SSI
Decreased Surgical Site Infections

Summary

- One size doesn't fit all
  - See what works at your institution
- CHP using combination
  - Pre-authorization
  - 3 day monitoring
  - Individual guidelines with specific group

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Recognizing the CHP ASP

- Clinical Pharmacy Team
  - Don Berry
  - Kelli Crowley
  - Elizabeth Ferguson
  - Denise Howrie
  - Bill Mcghee
  - Tan Nguyen
  - Carol Vetterly
  - Emily Polischuck
  - Jen Shenk
- Pharmacy
  - Jeff Goff
- Medical Director's Office
  - Ann Thompson
- Infectious Diseases
  - Brian Campfield
  - Toni Darville
  - Michael Green
  - Jim Levin
  - Ling Lin
  - Judy Martin
  - Marian Michaels
  - Andy Nowalk
  - Terri Stillwell
  - John Williams
  - ID Fellows
- GSPH Biostatistics
  - Maria Mori Brooks
  - Jong-Hyeon Jeong
  - Marcia Kurs-Lasky

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Questions?

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